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A summary of studies required to assess and minimize environmental damage due to tar sands development.

Second edition.

March 22, 1974

Prepared by:

Athabasca Tar Sands Task Force;

Environment Canada, Prairies and Northern Region

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Dr. Pratt

ATHABASCA TAR SANDS TASK FORCE

Terms of Reference

The responsibilities of the Task Force are to advise the Chairman of the DOE Management Committee, through the Chairman, Prairie and Northern Regional Board,

a) on expected environmental effects of hydrocarbon exploration, production and transportation in the Tar Sands area of northern Alberta and Saskatchewan, with particular attention to areas of national interest and concern.

b) on the design of a joint mechanism which would satisfy both federal and provincial responsibilities and requirements for investigations into aspects of impact, including long-term research.

c) on data and knowledge requirements and the means of satisfying them, with respect to means of assessing and minimizing environmental damage and rehabilitating surface-mined landscapes.

d) on the allocation of data collecting and research projects among public and private scientific agencies.

2. The Task Force will provide an initial report to the Chairman of the Board by 22 January, 1974, status reports to each Board Meeting (unless otherwise instructed), and other reports as required.

3. The Task Force will be convened by Dr. Drake Hocking of the Northern Forest Research Centre, CFS, Edmonton. Members shall be appointed to the Task Force by the Senior ADM, ES, and by the Regional Directors of EPS, CWS, AES, F&M, IWD and Lands having responsibilities in the provinces of Alberta and Saskatchewan. The Chairman, Dr. Hocking, may add to the Task Force in consultation with the Board.

4. The Task Force will not enter into any official or formal discussion with Provincial agencies or officials unless specifically instructed. Negotiation with the Provinces has been assigned by the Senior Management Committee to the ADM, EMS.

(approved Feb. 12, 1974)

OBJECTIVES

The purpose of the proposed Athabasca Tar Sands Environmental Research Project is to provide timely information about factors that will aid governments in establishing guidelines for the orderly development of the Tar Sands Area without socially unacceptable damage to biotic and abiotic resources and their present and potential uses.

To satisfy this purpose, the objectives of the proposed Athabasca Tar Sands Environmental Research Project are:

1. to identify the baseline states, processes, and absorptive capacity of the biotic and abiotic resources that may be affected by Tar Sands development activities;

2. to identify tar sands development activities that may affect biotic and abiotic resources;

3. to identify the nature of interactions between the various components of the biotic and abiotic environment and the various components of proposed development activities;

4. to predict, in part from information obtained by meeting objectives (1), (2) and (3), the individual and cumulative effects of anticipated developments on the biotic and abiotic environment;

5. to formulate and recommend measures, regulatory and technological, to minimize adverse effects and to maximize beneficial ones;

6. to make a preliminary environmental prediction statement by September 30, 1977; contingent upon adequate funding becoming available by September 30, 1974;

7. to make more refined statements upon completion of 5 and 10-year funding periods.

(Drafted by Department of the Environment H.Q. Steering Committee;
accepted with revisions by Regional Task Force)

A SUMMARY OF STUDIES REQUIRED TO ASSESS AND MINIMIZE
ENVIRONMENTAL DAMAGE DUE TO TAR SANDS DEVELOPMENT

This listing is comprehensive without regard to jurisdictional responsibilities. Suitable agencies to conduct the work or to oversee contracted research are shown with the lead agency first and major directly cooperating agencies following. Our perceptions of jurisdictional responsibilities are indicated in the "suggested cost sharing" columns.

The broad purpose and specific objectives of the proposed studies are described overleaf. Studies are related to the objectives and to each other. We consider that all studies relate to objectives 6 and 7 (making environmental predictions) and that their results should be published.

Recognizing that there will be fiscal constraints, we have given some indications of relative urgency of studies by their order of listing within sectors. But we regard this list as a minimum imperative. To place the need into perspective, the total estimated costs could be met by the proceeds of only a few days taxes or royalties on current petroleum exports.

We suggest that an administrative structure (overleaf) resembling that of the Peace-Athabasca Delta project should be established to implement coordinated research plans. Our primary conclusion is that a joint federal-provincial technical committee should be established without delay, to speed the detailed planning, integration and coordination of the required studies.

D. Hocking
Chairman

Northern Forest Research Centre
5320 - 122 Street
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March 21, 1974.

Task Force Members

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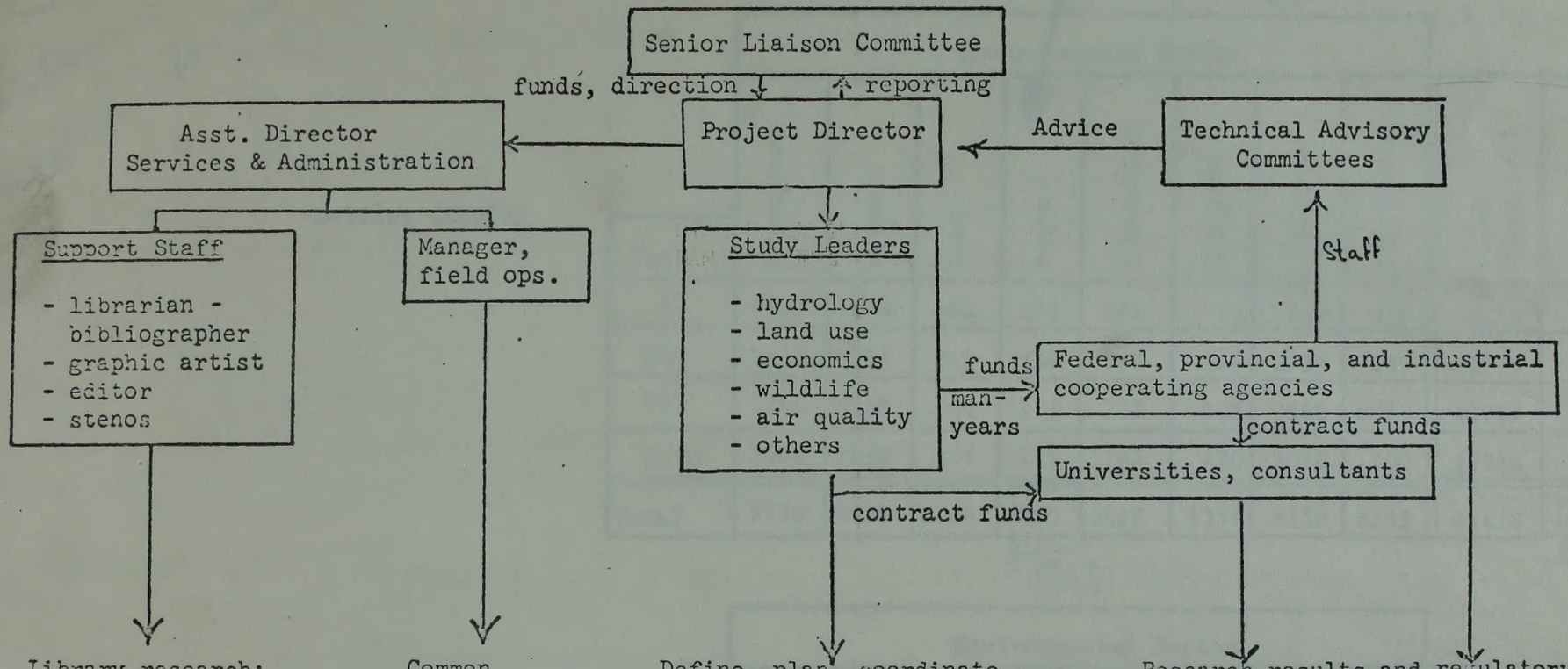
TAR SANDS ENVIRONMENTAL RESEARCH PROJECT

Suggested Structure



Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
1	510/8	33	33	33	170	-	170
2-3	780/28	33	33	33	260	-	260
4-5	780/28	33	33	33	260	-	260
6-10	1950/70	33	33	33	650	-	650
Total	4020/134	33	33	33	1340	-	1340

NOTE: Provision of support staff is to expedite the reporting and publication of data in retrievable format. There is no intention to pre-empt existing channels of publication.

ATHABASCA TAR SANDS ENVIRONMENTAL RESEARCH PROJECT - OVERALL COST SUMMARY

Approved by Envir. Can. for circulation - guidelines for committees

Told to stay out of it originally - biophysical emphasis - Human Environ. Comtee.

Dollars (X1000)

Year	Environmental Sector								Total (Research)	Coordination	Total
	Atmosphere	Water	Land	Human	Vegetation	Wildlife	Fisheries	Multisector			
1	4162	2090	560	148	354	75	750	330	8469	510	8979
2&3	1114	1983	945	330	767	515	2730	2195	10579	780	11359
4&5	1364	1338	530	100	735	295	2860	5020	12242	780	13022
6-10	3080	3619	125	222	1162	470	2010	700	11338	1950	12338
Total	9720	9030	2160	800	3018	1355	8350	8245	42678	4020	46698

!?!?

Man-Years

Year	Environmental Sector								Total (Research)	Coordination	Total
	Atmosphere	Water	Land	Human	Vegetation	Wildlife	Fisheries	Multisector			
1	107	149	19	8	12	4	23	10	332	8	340
2&3	54	141	31	18	29	27	76	12	390	28	418
4&5	52	96	18	5	28	18	79	17	313	28	331
6-10	143	257	5	12	44	28	51	10	550	70	620
Total	356	643	73	43	113	97	229	49	1583	134	1717

Total Federal Government Dollars (X1000)

Year	Environmental Sector										
	Atmosphere	Water	Land	Human	Vegetation	Wildlife	Fisheries	Multisector	Total (Research)	Coordination	Total
1	730	844	309	63	209	27	375	155	2712	170	2882
2&3	563	587	544	115	347	196	1365	765	4422	260	4682
4&5	803	420	197	40	344	115	1430	1740	5089	260	5349
6-10	1044	1179	42	112	661	177	1455	300	4970	650	5620
Total	3080	3030	1092	330	1561	515	4625	2960	17293	1340	18633

Federal Government Internal Dollars (X1000)

Year	Environmental Sector								
	Atmosphere	Water	Land	Human	Vegetation	Wildlife	Fisheries	Multisector	Total
1	250	724	134	31	189	27	325	130	1810
2&3	350	462	243	72	228	142	1075	190	2762
4&5	650	375	100	20	228	85	1150	290	2898
6-10	645	1024	-	50	305	127	1150	300	3601
Total	1895	2585	477	173	1050	381	3700	910	11071

Federal Government Contract or Cost-shared Dollars (X1000)

Year	Environmental Sector										
	Atmosphere	Water	Land	Human	Vegetation	Wildlife	Fisheries	Multisector	Total (Research)	Coordination	Total
1	454	120	175	33	20	-	50	25	877	170	1047
2&3	161	125	301	42	120	54	290	575	1668	260	1928
4&5	161	45	97	20	115	30	280	1450	2198	260	2458
6-10	419	155	42	62	256	50	305	-	1289	650	1939
Total	1195	445	615	157	511	134	925	2050	6032	1340	7372

Federal Government Internal Man-Years

Year	Environmental Sector								
	Atmosphere	Water	Land	Human	Vegetation	Wildlife	Fisheries	Multisector	Total
1	9	14	4	2	9	2	12	5	57
2&3	15	8	7	3	16	5	34	5	93
4&5	14	8	3	1	15	5	34	9	89
6-10	25	24	-	3	21	7	42	5	127
Total	63	54	14	9	61	19	122	24	366

ABBREVIATIONS OF AGENCY NAMES

Federal Agencies

AES	Atmospheric Environment Service
CFS	Canadian Forestry Service
CWS	Canadian Wildlife Service
EPS	Environmental Protection Service
FMS	Fisheries and Marine Service
IWD	Inland Waters Directorate
GSC	Geological Survey of Canada
DINA	Department of Indian and Northern Affairs
EMR	Department of Energy, Mines and Resources
LD	Lands Directorate
NPS	National Parks Service
ECC	Economic Council of Canada
NEB	National Energy Board

Science Council

Provincial Agencies

ADA	Alberta Department of Agriculture
ADOE	Alberta Department of Environment
ARC	Alberta Research (Council)
AFS	Alberta Forest Service
ERCB	Energy Resources Conservation Board
APk.B	Alberta Parks Branch
APl.B	Alberta Planning Branch
ADIC	Alberta Department of Industry and Commerce
AFW	Alberta Fish and Wildlife Branch

Private Agencies

DU	Ducks Unlimited
NTCL	Northern Transportation Company Limited
OSESG	Oil Sands Environmental Study Group

Atmospheric Research (Meteorological requirements)

The dispersion and deposition of pollutants depend largely on meteorological conditions (wind, turbulence, stability, precipitation etc). Aquisition of this knowledge of baseline meteorological data from the Tar Sands area is an essential pre-requisite for all research on air pollution and will require the establishment of a network of permanent meteorological stations. In addition, to provide data for atmospheric research and case studies, a series of intensive field surveys should be conducted using special equipment (aircraft, remote sensing, minisondes etc.) for limited periods during various seasons of the year over several years.

Research is required on Transport and Fallout of pollutants, both near the source and on a regional scale. This will require three-dimensional modelling of the airflow through the whole Tar Sands region. Modelling can be approached through two methods: firstly by utilizing a scale topographical model of the region in a wind tunnel and secondly by means of computer simulated numerical models. With such models the additive and/or synergistic effects of several large point sources in the valley, (eg. the drift of acid fog etc.) can be assessed. Other studies will be required on the evaporation from tailings ponds, fog, long range transport of pollutants, inadvertant climate or weather modification, chemical transformations of pollutants, precipitation scavenging, air pollution index forecasting etc.

Costs for the various projects were obtained by using $25,000 per year for a professional Man Year, and $12,000 for a technician M/Y. Capital costs were based on rough estimates and normally were included in the first year of the project.

The Regional Air Pollution Prediction, Dispersion, and Fallout Model includes the costs for several separate models (valley airflow model, atmospheric model, pollution contaminants model, dispersion model, fallout model). Output from this model on the deposition of contaminants would be used as input to the other SECTORS eg. for the water pollution model.

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
A.1 Meteorological Network for Air Pollution Studies A network of additional meteorological stations is required in the Athabasca Oil Sands area to determine the airflow and precipitation patterns involved with all air polution studies.	- Collection of baseline meteorological data for use in air pollution studies									
A.1.1 Five valley climatological stations (semi-automatic recording instruments) measuring temperature, wind and precipitation. Baseline data first priority. - relates to objective #1 - complements study A.5, L.2 - essential prerequisite to A.2, A.3, A.4, A.5, A.6	- To provide basic background climatological data for all research projects on air pollution. - To provide baseline data for the development of a regional air pollution model.	AES ADOE EPS	1 2 & 3 4 & 5 6 -10	74/2 48/4 48/4 120/10	20 20 20 20	20 20 20 20	60 60 60 60	14.8 9.6 9.6 24.0	- - - -	14.8 9.6 9.6 24.0
			Total	290/20	20	20	60	58.0	-	58.0
A.1.2 One Minisonde synoptic weather station plus air cuality instruments (Ft. Mackay). Sounding of the lower levels of the atmosphere for temperature, pressure, and wind. Baseline data first priority - relates to objective #1 - complements study A.5, L.2 - essential prerequisite to studies A.2, A.3, A.4, A.7, A.5, A.6	- To provide baseline meteorological data for all air quality and air pollution research. - To provide data for the study of airflow, temperature inversions, three dimensional structuring of the atmosphere. - For input data in the development and operation of the Regional Air Pollution Prediction, Dispersion and Fallout model.	AES ADOE EPS	1 2 & 3 4 & 5 6 - 10	148/4 96/8 96/8 240/20	50 50 50 50	50 50 50 50	- - - -	74 48 48 120	- - - -	74 48 48 120
			Total	580/40	50	50	-	290	-	290

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
1 Meteorological Network (continued)										
1.3 One 300 ft. Meteorological Tower - in the Tar Sands area, instrumented for recording wind, temperature and air pollution - basic data required for the development of regional air pollution model. - relates to objectives #1 - complements study A.6 and A.7, A.5 - essential prerequisite to studies A.2, A.3, A.4, A.5, A.6	- To obtain low level vertical profile data for airflow, temperature inversions, and pollution research. - To provide meteorological data for the development and operational use of the air pollution computer model.	AES ADOE EPS	1 2 & 3 4 & 5 6 - 10	150/1 10/2 10/2 25/5	50 50 50 50	50 50 50 50	- - - -	75 5 5 12.5	- - - -	75 5 5 12.5
			Total	195/10	50	50	-	97.5	-	97.5
1.4 One Air Quality and Climatological Station (Birch Mountain) - solar radiation measurements, temperature and wind recorded data. - relates to objective #1 - complements study A.5 - essential prerequisite to studies A.2, A.3, A.4, A.5, A.6	- To provide baseline meteorological data for air pollution studies. - For comparison with data from valley stations re radiation, and climatic effect	AES ADOE EPS	1 2 & 3 4 & 5 6 - 10	15/1 10/2 10/2 25/5	50 50 50 50	50 50 50 50	- - - -	7.5 5.0 5.0 12.5	- - - -	7.5 5.0 5.0 12.5
			Total	60/10	50	50	-	30.0	-	30.0

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
1 Meteorological Network (continued)										
1.5 Minisonde Instrument Observation - low level atmospheric sounding added to the Fort McMurray Weather Station. - relates to objective #1 - essential prerequisite for studies A.2, A.3 A.4, A.5, A.6	- To obtain baseline meteorological data - To obtain vertical profiles of wind and temperature for input to Air Pollution Dispersion model and air pollution research.	AES ADOE EPS	1 1 & 2 2 & 3 6 - 10	50/1 50/2 50/2 100/5	100 100 100 100	0 0 0 0	0 0 0 0		50/1 50/2 50/2 100/5	50 50 50 100
			Total	250/10					250/10	250
1.6 Rawinsonde Station (Fort McMurray) - complete upper air sounding capability added to the Ft. McMurray weather station. - for research on long range dispersion of pollutants. - this project has a lower priority than A.1.1 to A.1.5 and could be delayed for a few years. - relates to objective #1 - complements studies A.2, A.3, A.4, A.5, A.6 M.3, M.4 , A.7, L.2 - prerequisite to studies A.5, A.6	- To obtain baseline meteorological data - High level sounding of atmospheric conditions for three dimensional study of transport and dispersion of pollutants, inversions, winds, etc. - Data input to Regional Prediction Dispersion Fallout model and air pollution research.	AES ADOE EPS	1 2 & 3 4 & 5 6 - 10	- - 350 320/10	- - 100 100	- - - -	- - - -		- - 350/0 320/10	- - 350 320
			Total	670/10	100	-	-		670/10	670

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
.2 Regional Air Pollution Prediction, Dispersion, and Fallout model										
- development of computer programs and models for the prediction, dispersion, and fallout of pollutants from multi-sources in the Tar Sands area - to determine serious air pollution situations and concentrations - to determine the dispersion of pollutants under various atmospheric conditions - to determine the fallout of the different contaminants - relates to objectives #1, #2, #3, #4, #5. - follows studies A.1, A.6, A.4 - complements A.3, A.7, F.4, F.6, W.11, V.6, A.1, A.5, A.6, F.3, G.5 - essential prerequisite to studies A.4, M.4, M.3, M.5, H.1, F.6	- To project the distribution and composition of aerial contaminants and the prediction of the Fall-out of pollutants. - For operational use in calculating the pollution index and for use with air pollution control measures. - For the planning of plant locations, plant design - stack heights, etc. - For use in determing the depositing of aerial contaminants on to land, water, and vegetation.	EPS AES ADOE	1 2 & 3 4 & 5 6 - 10	200/6 200/6 100/4 200/10	50 50 50 50	50 50 50 50	- - - -	- - - -	100/3 100/3 50/2 100/5	100 100 50 100
			Total	700/26					350/13	350
.3 Air Pollution Forecast Office										
- establishment of an operational office to monitor and forecast air pollution conditions, based on meteorological forecasts, air pollution data, and the Regional Air Pollution Model (A.2). - five year development then continuing operational office - relates to objectives #1, #2, #3, #4 - follows studies A.1, A.6, A.4 - complements studies A.2, A.7, F.4, F.6 W.11, A.5, A.6 - prerequisite to studies M.3, M.5	- To provide forecasts of air pollution for use in controlling air pollution. - To provide continuing research in air pollution forecasting.	AES ADOE EPS	1 2 & 3 4 & 5 6 - 10	50/2 100/4 100/4 1,250/50	50 50 50 10	50 50 50 90	- - - -	- - - -	25/1 50/2 50/2 125/5	25 50 50 125
			Total	1500/60					250/10	250

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Interval $000/MY	Total $000
A.4 Air Pollution Research (Meteorology)										
- diffusion of pollutants from single and multiple sources. - limited duration field studies using mobile minisonde, aircraft and remote sensing techniques. - meteorological effect of the oil sands development, evaporation from tailings ponds, chemical reactions in clear atmosphere and precipitation (acid rain), fog formation. - study of meteorological conditions producing a high pollution potential - relates to objectives #2, #3, #4 - follows studies A.1, A.5, A.2 - complements A.7, A.1, A.5, A.6 - essential prerequisite to studies A.2, A.3, M.3, M.4, M.5	- To determine the addition and/or synergistic effects of multiple sources. - To determine the three dimensional structure of the atmosphere, the airflow in the valley, temperature inversions, and the transport of pollutants. - To determine the disposition of pollutants - acidification of soils and water in surrounding region. - Inadvertant weather modification - To develop techniques for forecasting periods of high pollution potential.	AES ADOE EPS	1 2 & 3 4 & 5 6 - 10	150/8 300/16 300/16 -	50 50 50 -	50 50 50 -	- - - -	- - - -	75/4 150/8 150/8 -	75 150/4 150/8 -
			Total	750/40	50	50	-	-	375/20	375

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Interval $000/MY	Total $000
5 Air Pollution Monitoring Network - relates to objective #1, #2 - compl ments studies A2, A3, A4, A1, A6 - essential prerequisite to studies A7, V6, A4, M3, M4, M5 - based on study A1	- to establish a general network of stations to minotor the air quality associated with tar sands developments (existing requirement of Alberta Govt. DOE).	ADOE EPS	1	2425/50	0	0	100	0	0	0
			2 & 3							
			4 & 5							
			6 - 10							
			Total	2425/50						
6 Stack Emissions Monitoring - relates to objective #1, #2 - complements A2, A3, A4, A5, M1,1, A1 - essential prerequisite to M3, M4, A2, A3, F6 - based on study A1	- to determine the composition of source emissions - to ensure compliance with existing legislation - to assist in evaluating the adequacy of existing technology to control aerial emissions	ADOE EPS	1	100/1	33⅓	33⅓	33⅓	133.3	0	133.3
			2 & 3	100/3	"	"	"	33.3	0	33.3
			4 & 5	100/3	"	"	"	33.3	0	33.3
			6 - 10	300/10	"	"	"	100.0	0	100.0
			Total	300/30				299.9	0	299.9
7 Contribution of airborn contaminants to aquatic and terrestrial ecosystems - relates to objectives #2 and #3 - complements studies W9, V6, F4, W8, W10, W11, A1, A2, A3, A4, F6 - essential prerequisite to M3, V1, G5, M2, M4, W11 - based on studies A1, A5	- to determine changes in chemical composition of abiotic and biotic environmental components in relation to the dispersal of airborn contaminants - to assist other disciplines in defining the zone of contamination - to assist in the development of new guidelines, regulations or legislation for the control of specific pollutants	EPS ADOE	1	500/18	50	50	0	150	100 / 1	250
			2 & 3	200/7	"	"	"	60	40 / 2	100
			4 & 5	200/7	"	"	"	60	40 / 2	100
			6 - 10	500/18	"	"	"	150	100 / 5	250
			Total	1400/50				420	280 / 10	700
	Atmospheric Sector	Total	1	4162/107				454.6	250/9	730.6
			2&3	1114/54				160.9	350/15	502.9
			4&5	1364/52				160.5	650/14	802.9
			6-10	3080/143				419.0	645/25	1044.0
			Total	9720/356				1195.4	1895/63	3080.4

velopment of the Athabasca Tar Sands will have an impact on water resources in the Athabasca River, Lake Athabasca, lave River and Great Slave Lake. Extraction of bitumen from the Athabasca Oil Sands by surface mining will have a jor impact on the hydrology of the areas immediately adjacent to each mine, and an impact on any drainage system ceiving discharge from the mining or processing areas. Conversely, the hydrology will have a major impact on the ining operations. The exact nature of these impacts is difficult to evaluate, because:

(a) both surface and subsurface hydrologic systems of the lower Athabasca River basin are poorly known,

(b) the exact nature, amounts and ultimate fate of effluent and tailings materials are uncertain,

(c) the degree of utilization of the waters within each basin and the possible physical changes to each basin are essentially unknown, and

(d) the nature and stability of the post-mining landscape, including particularly the success of reclamation and revegetation is open to speculation.

t present it is not possible to predict even the simpler natural hydrologic characteristics of the river, nor is there ny real idea of the effect of the effluents produced by the tar sands plants. The initial emphasis in the water sector tudies should be on gathering sufficient information that the questions implied in items (a), (b) and (c) can be nswered, and, hence, item (d) appraised.

ufficient data are needed to simulate surface runoff through the mining areas and to simulate groundwater flow systems n the mining areas; background data are needed on the physical and chemical characteristics of rivers and streams to etermine present status, and so that pollution loads and other changes can be monitored. It is necessary to know, among ther things: flood flows, to decide on the needs for and designs of stream diversions; the low-flow characteristics of treams, for pollution control; and the severity of ice runs, again for flood information and diversion designs.

o obtain this information, it will be necessary to:

(1) inventory the hydrologic resources in the drainage basins likely to be affected by mining in the near future,

(2) develop models of hydrology, water quality and sedimentation and erosion in the system for predictive purposes.

(3) conduct a detailed examination of existing operations, to study water use and water wastes, including drainage of mining areas, tailings ponds, etc. in order to develop control strategies.

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Flow and Water Level Studies in Athabasca - Slave River Basins to Outlet Great Slave Lake. (Gauging Station Network on Main Stems, Tributaries and Lakes within the Basins.) - Relates to Objective #1 - Prerequisite to studies W4, W5, W6, W11, G5, F7, F8 - Based on Study # - Complements Study #G5, L2	Basic background flow data for pollution studies, sedimentation studies, engineering studies and any modelling studies required.	IWD, ADOE, DINA, FMS	1	600	60	40	-	-	360/8	360
			2 & 3	267	"	"	"	-	160/3	160
			4 & 5	267	"	"	"	-	160/3	160
			6-10	666	"	"	"	-	400/10	400
			TOTAL	1800	40				1080/24	1080
Sedimentation Studies in the Athabasca-Slave River System - to outlet of Great Slave Lake. - Relates to Objective #1 - Prerequisite to studies #W5, W11, G5, - Based on studies # F4 - Complements studies # G5, M1.2	To determine sedimentation effects of the mining on water transportation and Peace Athabasca eco-system, and to develop a sedimentation model.	IWD, ADOE, DINA, NTLL, FMS	1	300	60	40	-	-	180/3	180
			2 & 3	71	"	"	"	-	42.6/1	42.6
			4 & 5	71	"	"	"	-	42.6/1	42.6
			6-10	178	"	"	"	-	106.8/2	106.8
			TOTAL	620/12					372/7	372
Water Quality Studies in the Athabasca-Slave River System - to outlet of Great Slave Lake. - Relates to Objective #1 - Prerequisite to studies #W6, W8, W9, W11, G5 - Based on studies # - Complements studies #L2, F5, F7, F8	Monitor the water quality of the Athabasca-Slave and its tributaries and surrounding lakes to determine changes in water quality and to aid in tracing down the sources of the contaminants. To develop a Water Quality model of the system.	IWD, ADOE, DINA, EPS, FMS	1	140	35	35	30	-	49/1	49
			2 & 3	320	"	"	"	-	112/2	112
			4 & 5	320	"	"	"	-	112/2	112
			6-10	800	"	"	"	-	280/5	280
			TOTAL	1580/29					553/10	553

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
4. Hydrologic Model of Athabasca-Slave River System to mouth of Great Slave Lake. - Relates to Objectives # 3 & 4 - Prerequisite to studies #W10, W11, G5 - Based on studies #W1 - Complements studies #W5, W6, V1, G5, F3, A2	Project changes in water levels in Peace-Athabasca Delta. Great Slave Lake, and Great Slave Lake Delta. Provide flow data for sedimentation and water quality models.	IWD ADOE DINA	1	50	50	50	-	-	25/.2	25
			2 & 3	60	"	"	"	-	30/.3	30
			4 & 5	20	"	"	"	-	10/.1	10
			6-10	50	"	"	"	-	25/.9	25
			TOTAL	180/3					90/1.5	90
5. Sedimentation and Erosional Model. - Relates to Objectives 3 & 4 - Prerequisite to studies #W11, V1, F4 - Based on studies #W1, W2 - Complements studies #W4, W5, V1, G5, F3, A2	Project sedimentation changes in the Athabasca River, Peace-Athabasca Delta, Slave River, and Great Slave Lake Delta.	IWD ADOE DINA	1	50	50	50	-	-	25/.2	25
			2 & 3	55	"	"	"	-	27.5/.3	27.5
			4 & 5	10	"	"	"	-	5/.3	5
			6-10	25	"	"	"	-	12.5/.7	12.5
			TOTAL	140/3					70/1.5	70
6. Water Quality Model - Relates to Objectives 3 & 4 - Prerequisite to studies #W11, F3 - Based on studies #W1, W3, F7, F8 - Complements studies #W4, W5, V1, G5, F3, A2	Predict changes in the water quality of the system for both continuous and drastic (catastrophic) inputs.	IWD ADOE DINA EPS	1	100	50	50	-	-	50/.5	50
			2 & 3	110	"	"	"	-	55/.5	55
			4 & 5	20	"	"	"	-	10/.2	10
			6-10	50	"	"	"	-	25/.3	25
			TOTAL	280/3					140/1.5	140
7. Groundwater Monitoring - determine flow direction, level and quality. - Relates to objectives 1 & 3 - Prerequisite to studies # G7, W11, V5 - Based on studies # - Complements studies # V1, L2	To initially determine groundwater sources and quality and to identify flow direction. To determine possible flow of contaminants and effect of tailings ponds on groundwater quantity and quality.	ARC ADOE IWD EPS FMS	1	500	-	70	30	-	-	-
			2 & 3	700	"	"	"	-	-	-
			4 & 5	400	"	"	"	-	-	-
			6-10	1000	"	"	"	-	-	-
			TOTAL	2600	60			-	-	-

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
8. Investigation of restoration of water quality in reclaimed and disturbed areas. - Relates to objectives #2, 3, 4 and 5 - Prerequisite to M4, G6, W11 - Based on studies # V1, W3, F6 - Complements study A7, L4, V4, G2, G5, G7	To determine restorative techniques that contribute to fish and wildlife management and associated recreation.	CWS EPS ADOE IWD FMS	1	-/0	33	33	33	-	-	-
			2 & 3	-/0				-	-	-
			4 & 5	30/1				10	-	10
			6-10	300/15				100	-	100
			TOTAL	330/16				110	-	110
9. The Fate of non-degradable and degradable contaminants. - Relates to objective #3 - Prerequisite to study M2, M4, G6, W11 - Based on studies # W3 - Complements studies A7, F1, W10, M1.2	To determine how emitted products change over time. To determine the zone of influence of the resulting contaminants. To identify the need for control methods.	EPS IWD FMS	1	100/5	35	35	30	0	35 / 1	35
			2 & 3	200/10	"	"	"	35	35 / 1	70
			4 & 5	200/10	"	"	"	35	35 / 1	70
			6-10	300/15	"	"	"	55	50 / 2	105
			TOTAL	800/40				125	155 / 5	280
10. Waste Water Inventory: GCOS . - Relates to objectives #2 and 5. - Prerequisite to studies # - Based on studies # W4 - Complements studies A7, W9, V8, G2 F1, F5, F6	To determine the source (o), composition and flows of waste water outputs from the existing GCOS operations for use as a first out model.	EPS ADOE	1	150/3	50	50	0	75	-	75
			2 & 3	-				-	-	-
			4 & 5	-				-	-	-
			6-10	-				-	-	-
			TOTAL	150/8				75		75
11. Water Pollution Impact Predictions. - Relates to objective #4 - Prerequisite to study M2 - Based on studies A7, W4, W5, W6, W7, W8, W9, G2, F1 - Complements studies # A2, A3, A7	To develop water pollution control strategies using Water Quality Model, Sedimentation Model and Hydrology model.	EPS ADOE FMS CWS IWD	1	-				-	-	-
			2 & 3	-				-	-	-
			4 & 5	-				-	-	-
			6-10	250/14	50	50	0	0	125 / 3.5	125
			TOTAL	250/					125 / 3.5	125

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Tailings Pond Hydrology - relates to objective # 3, 5 - prerequisite to study # V7, V8 - based on studies # - complements studies # G6, M1.2	- to determine water balance and the movement of pollutants in tailing pond areas	EPS ADOE ARC	1 2&3 4&5 6-10	100/5 200/10 --- ---	45 "	45 "	10 "	45 90 --- ---	--- --- --- ---	45 90 --- ---
			Total	300/15				135	---	135
	Sector Totals		1	2090/149				120	724/14	844
			2&3	1983/141				125	462/8	587
			4&5	1338/96				45	375/8	420
			6-10	3619/257				155	1024/24	1179
			Total	9030/643				445	2585/54	3030

LAND

Baseline information on terrain characteristics and land use is prerequiste to the preparation of environmental impact prediction statements.

Some information on basic terrain characteristics is available for the Tar Sands area but it is generalized and not uniform for the entire area. Existing information about both soils and surficial deposits was obtained from aerial photographs; field checks of these data were limited. Supplementary systematic terrain analysis should be made to verify and integrate existing information with additional bio-physical data relevant to resource management in The Tar Sands area. A bio-physical inventory for that and adjacent affected areas is proposed to meet this need.

Some baseline data on existing resource use is available for the Tar Sands area. Updating, consolidating, supplementing, and projecting is required to make accurate predictions about future impacts on the Tar Sands and adjacent environments.

The restoration of terrain form and composition, particularly in surface mined areas, will be an important factor in creating surface stability, biological productivity, and visual quality after bitumen has been extracted and refined.

The development of a land use plan is a major mechanism for achieving the orderly development and protection of the natural resource base in the Tar Sands and adjacent affected areas. The land use planning proposals will be dependent upon the findings of most other studies.

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
1. An inventory and consolidation of present resource utilization information to encompass land, water, vegetation, and wild life; projections of increased requirements due to improved access and increased human populations - Relates to objective No. 2 - Essential prerequisite to V2, V3, G2, H1 - Based on G1, F2, F3 - Complements F2, G1, G3, H4	Basic requirement for assessing future impact on, and use of, the natural resource base.	API.B L D DIANA	1	100/4	33	66	--	33	--	33
			2-3	50/2	33	66	--	17	--	17
			4-5	50/2	33	66	--	17	--	17
			6-10	125/5	33	66	--	42	--	42
		Total		325/13				109		109
2. A detailed biophysical/inventory of lands and engineering geology likely to be affected by resource developments - Relates to objective No. 1 - Essential Prerequisite to G2, L4, V1, V2, G1, H1, H4 - Based on G1, F2 - Complements F1, F7, W1, W3, W7, G1, G4, A1, F8	To provide baseline biophysical data for: other study projects; impact assessments; and land use planning.	LD, EMR CWS CFS AFW AFS	1	220/7	80	20	--	102	84/3	186
			2-3	415/13	80	20	--	204	143/5	347
		Total		635/20				306	227/8	533

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
3. Surface land form restoration; determination of optimum form and surface composition of mined and spoil areas. - Relates to objective no. 2 - Essential prerequisite to V1, V5 - Based on V6, V7, V8 - complements V1, V2, V4, V5, V7, V8, G2 G2, W8, H1	To guide mine pit engineering, handling of overburden, and reclamation scheduling	EMR	1	120/4	33	33	33	---	40/ 1	40
		ARC	2-3	240/8	33	33	33	---	80/ 2	80
			4-5	240/8	33	33	33	---	80/ 2	80
		Total		600/ 20					200/ 5	200
4. Development of a land use plan for the Tar Sands area - Relates to objective no. 5 - Essential prerequisite to V5 - Based on V3, V5, V6, G2, G3, G4, G5, G7, H1, H4 - complements G3, V1, V2, W8, H1	A framework for regulating resource use.	API.B	1	120/4	50	50	---	40	10/ 0.25	50
		LD	2-3	240/8	50	50	---	80	20/ 0.5	100
			4-5	240/8	50	50	---	80	20/ 0.5	100
		Total		600/20				200	50/ 1.25	250
Sector Totals			1	560/19				175	134/4.25	309
			2-3	945/31				301	243/7.5	544
			4-5	530/18				97	100/2.5	197
			6-10	125/5				42	---	42
		Total		2160/ 73				615	477/14.25	1092

Development of the tar sands will be by and for the human sector
the environment, requiring unprecedented inputs of human resources. It
ll have primary and secondary physical effects on the lives of many. And
e way in which development proceeds will affect attitudes and values of
ople not directly affected physically or economically.

A first-order analysis demands examination of the likely effects
the lives of people physically living in the area. This includes both
tive people living on the renewable resources; and the construction,
eration and support personnel concerned with tar sands extraction.

The second-order analysis looks at the broader economic effects
er the province and nation as a whole, and includes evaluation of
ternatives.

Finally, we have identified a need to consider the difficult,
tangible effects on real and vicarous satisfactions; on environmental
titudes and values elsewhere.

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Population growth projection of Tar Sands area and support requirements: education, accommodation, water supply and sewage disposal, power supply, recreation, etc; development of Ft. McMurray and/or new towns -relates to objective #3,4,5 -essential prerequisite to study # L.4 -based on study #L.1, L.2, F.2, A.2 -complements study #L.3, L.4, H.2, H.4	To ensure development of a stable, integrated, pleasant community.	APlB	1	10	-	100	-	-	-	-
			2-3	60						
			4-5	60						
			6-10	110						
			Total	240/1	-	100	-	-	-	-
Sociological impact of tar sands development on the native peoples of the area: livelihood, social structures; planning and implementation of alternatives. - relates to objective #1,3,5 -essential prerequisite to study # -based on study #H.3, V.3, -complements study #H.1, V.3, V.5,G.1,F.3	Minimize social disruption of native peoples and ease transition to alternative life styles.	DINA	1	8	100	-	-	-	8/.5	8
			2-3	40				20	20/1	40
			4-5	40				20	20/1	40
			6-10	112				62	50/2.5	112
			Total	200/1	100	-	-	102	98/5	200
Economic projections of impact on employment and direct income gener[illegible] secondary effects in provincial and federal economies, including evaluations of impact when various alternative capital sources are used. - relates to objective #4, 5 -essential prerequisite to study #H.1, H.2, M.1, G.3, F.3 -based on study # -complements study #H.5, V.3	Permit better planning, essential input for other studies.	ADIC ECC NEB	1	40	25	75	-	-	10/.5	10
			2-3	160				-	40/2	40
			4-5	-				-	-	-
			6-10	-				-	-	-
			Total	200/1	25	75	-	-	50/2.5	50

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
L.4 Survey of total area for unique geological, archeological or ecological areas. -relates to objective #1,4,5 -essential prerequisite to study # L.4 -based on study #L.2, G.4, F.7 -complements study #L.1, H.1, G.1, V.6	Permit preservation as natural or historical areas.	APkB GSC	1 2-3 4-5 6-10 Total	50 50 - - 100/4	50	50	-	12.5 12.5 - - 25	12.5/.5 12.5/.5 - - 25/1	25 25 - - 50
L.5 Effect of tar sands development and how it is controlled, on environmental quality values elsewhere. -relates objective #4,5 and preamble -essential prerequisite to study # -based on study # -complements study #M1.1, M1.2, M1.3, H.3	A guide to public perceptions.	ADOE	1 2-3 4-5 6-10 Total	40 20 - - 60/3	50	50	-	20 10 - - 30	- - - - -	20 10 - - 30
	Sector totals.		1 2-3 4-5 6-10 Total	148 330 100 222 800/ 43				32.5 42.5 20 62 157	30.5/1.5 72.5/3.5 20/1 50/2.5 173/8.5	63 115 40 112 330

"Significant areas of the tar sand regions support commercially-exploitable forest. The vegetative communities on these areas, and even more so the remaining non-commercial areas, are relatively fragile and slow to recover after disturbance. Exploration phases of industrial development will necessitate some disturbance from access road building and clearing for plant and test sites. The most drastic disturbance will occur on those areas of the Athabasca deposit on which the oil-bearing cover is less than 200 feet below the surface. Such areas, estimated a total 800 to 900 square miles, occur principally in a broad band along the Athabasca watershed from the vicinity of Fort McMurray to Township 99, 50 miles north. Mining on these areas will probably involve the currently practiced strip-mining method whereas mining at greater depths will probably involve in situ techniques now under development". (Working group report.)

Surface disturbance will be total on the strip-mined areas, requiring re-building of a productive soil profile. Vegetation disturbance will be extensive with in situ techniques, probably requiring clearing and reforestation but not requiring large-scale renewal of the landscape and soil.

"The ERCB report estimates that operations projected for the next decade will necessitate stripping between 3 to 4 square miles/year. At the end of the decade the disturbed areas would total at least 34 square miles, lying for about 10 square miles prepared for mining, an equal area being mined and about 14 square miles being backfilled and revegetated. It further estimates that using average forest inventory data for the area, an area of forest presently representing 1 million board feet of commercial lumber, 6 million cubic feet of commercial roundwood and nearly 6 million cubic feet in non-/or-marginally-commercial stands, would be eliminated. With the almost certain assumption that disturbed areas will revegetate to commercial forest very slowly, if ever, the prospect is that such areas will become non-productive for wood fibre production indefinitely. This loss might be mitigated by preserving and restoring the topsoil level instead of burying this with sub-soil material as is the present practice. In addition to lack of fertility in the sub-soil, residual bitumen and other chemicals contained in the overburden and worked sand will further inhibit normal productivity". (Working group report.)

Besides the physical disturbance of soil and vegetation occasioned by mining activities, vast amounts of sulphur dioxide will be emitted as a result of processing the bitumen. There is only sketchy and generalized knowledge of the effects of sulphur dioxide on vegetation. To guide land reclamation and re-vegetation, as well as to maintain optimal productivity of existing forests, sophisticated and rational management of emissions based on detailed knowledge of their effects, is needed.

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
V.1 Revegetation of: -clean sand -dirty stablized tailings -returned overburden	Reclamation and return to productivity of disturbed lands	ADA	1	100	30	50	20	0	30/2	30
		CFS	2-3	400				60	60/4	120
		ARC	4-5	400				60	60/4	120
		AFS	6-10	500				50	100/5	150
V.1.1. Planning (refer to Lands Sector).		LD								
		APkB	Total	1400/	30	50	20	170	250/15	420
V.1.2. Selection of suitable primary and secondary species: mosses, grasses, herbs, shrubs, hardwoods, conifers.		CWS		50						
		GSC								
		OSESG								
		EMR								
V.1.3. Soil and topographical preparation for planting: -maximum slopes; drainage; contours. -neutralization or acidification of soils and/or parent material. -addition of mulches (peat from overburden). -fertilization.										
V.1.4. Planting methods: seeding of grasses and herbs; planting methods for woody species; seed collection, handling, preparation, storage, distribution. -relates to objective #5 -essential prerequisite to study #G.6, G.7, W.8, V.5 -based on study #L.2, L.3, W.5, A.7. -complements study #L.3, L.4, W.4, W.7, V.2, V.5, V.8, G.7, M1.3	V.2, V.4, V.6									

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
2. Salvage and storage methods for muskeg and peat: planning, engineering, movement and disposal. -relates to objective #5 -essential prerequisite to study #V.1, G.7 -based on study #L.1, L.2 -complements study #V.1, V.4, V.5, L.4, L.3, G.7	For future use in revegetation	ARC ADA CWS CFS EPS OSESG	1 2-3 4-5 6-10 Total	20 50 30 - 100/5	25	25	50	- 10 5 - 15	5/.5 2.5/1 2.5/.5 - 10/2	5 12.5 7.5 - 25
3. Harvesting plan for timber removal and utilization; prior to overburden stripping or major in situ development. -relates to objective #1, 5 -essential prerequisite to study #L.4, H.3 -based on study #L.1, L.2 -complements study #H.2, H.3, G.7	Salvage of existing surface resource. Potential jobs for local people.	AFS CFS	1 2-3 4-5 6-10 Total	10 10 - - 20/1	10	90	-	- - - - -	1/.05 1/.05 1/.05 - 2/.1	1 1 - - 2
4. Establishment of soil and root microflora on reclaimed lands. -relates to objective #3,5 -essential prerequisite to study #V.1, V.5 -based on study # -complements study #V.2, V.5, G.7, L.3, W.8	Essential to revegetation of sterile tailings and parent materials.	CFS ADA	1 2-3 4-5 6-10 Total	20 90 90 40 240/1	50	50	-	- 10 10 - 20	1/.5 35/2 35/2 20/1.5 100/5	10 45 45 20 120
5. Requirements for the tending and protection of new forest plantations and grasslands. -relates to objective #5 -essential prerequisite to study # -based on study #V.1 -complements study #V.1, V.2, V.4, G.7, L.3, H.2	To guide gradual reclamation of productive forest land.	CFS AFS ADA CWS OSESG	1 2-3 4-5 6-10 Total	2 4 8 22 36/2	50	50	-	- - - 6 6	1/.1 2/.2 4/.2 5/.5 12/1	1 2 4 11 18

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Effects of SO_2 and heavy metal emissions on vegetation: toxicology, physiology, ecology, synergisms, predispositions; trees, shrubs, mosses, lichens. Requires inputs from studies of quantities and dispersion under atmosphere. -relates to objective #3,4,5 -essential prerequisite to study #M.1.1, V.1 -based on study # A.5 -complements study # A.2, A.5, H.4, M1.3	Threshold levels for damage. Effects on wildlife fodder. Predispositions to other environmental stresses. Tolerance of species used for reclamation. Rationalization of emission standards.	CFS AFS EPS ADOE	1 2-3 4-5 6-10 Total	200 200 200 600 1200/40	80	10	10	20 40 40 200 300	140/6 120/8 120/8 280/14 660/36	160 160 160 480 960
Effects of ice fogs on vegetation; survey of extent, rates of condensation; breaking stresses of trees. -relates to objective #3,4,5 -essential prerequisite to study #L.3, G.5, G.7 -based on study #W.12 -complements study #M.1.2, L.3, G.6	Determine potential extent of damage and result. Possibly beneficial to wildlife browse.	CFS CWS	1 2-3 4-5 6-10 Total	- 3 3 - 6/.3	100 100	- -	- -	- - - - -	- 3/.15 3/.15 - 6/.3	- 3 3 - 6
Effects of seepage from tailings ponds on vegetation (see also Water Sector). -relates to objective #3,4,5 -essential prerequisite to study #L.3, M.2, M.4 -based on study #W.12 -complements study M.1.2, V.1, L.3, W.10, G.6	Aid in criteria-setting for better design of tailings ponds.	CFS ADA	1 2-3 4-5 6-10 Total	2 4 4 - 10/.5	100 100	- -	- -	- - - - -	2/.1 4/.2 4/.2 - 10/.5	2 4 4 - 10
	Sector Totals		1 2-3 4-5 6-10 Total	354 767 735 1162 3018/113				20 120 115 256 511	189/9.2 227.5/15.4 228.5/15.1 305/21.3 1050/61	209 347.5 343.5 561 1561

The Resource

Most of the common upland wildlife species of the prairie boreal forest occupy the area that will be influenced by tar sands development. This includes big game species such as moose, white-tailed deer, mule deer, etc. along with many smaller mammals and numerous birds. The general area also forms a vital migration link for migrating birds traversing from the prairies to the Arctic via the deltas of the Peace, Athabasca and Mackenzie rivers. During drought years on the prairies this area increases in value as a breeding area and provides some of the necessary insurance in the continental waterfowl populations.

To date the use of wildlife resources within this area has been relatively limited due to sparse human populations. Native use has been reasonably high, and they are reasonably dependant on the big game resource for food and furbearers as an income source. With the increased demand created by the influx of people to the tar sands the limited wildlife resources of this area will have to be carefully managed to fill the increased demand.

Anticipated Conflicts

In addition to greatly increased demands for these resources, the physical disturbance caused by development of the tar sands will have profound impacts. The wildlife of the area is directly related to the quality and quantity of available habitat. The effects of tar sand development will be widespread and not limited only on the area of development. Changes in water quantity and quality could affect wildlife populations or far downstream on the mouth of the Mackenzie and atmospheric pollution and the resulting vegetation changes could extend for hundreds of miles.

Many acres (up to 345 square miles per year) of habitat will be totally eliminated through mining operations, some of which may be replaced by subsequent reclaimation measures; dramatic changes will occur in the flows and quality of water in the Athabasca and many of its tributaries with accompanying alteration in habitat throughout the lower reaches of the watershed; tailing ponds (estimates at up to 105 square miles each) will provide attraction areas, or possibly death traps for the millions of migrating birds that pass through this area every year.

Study Requirements

The studies outlined in this section are those that pertain directly to the wildlife resource and as such reflect only a small part of the inputs that are required for wildlife. Many of the studies in atmosphere, water, land and forestry will provide the essential base data on which to extrapolate effects on wildlife and its habitats hence it is essential that wildlife inputs be included in the design of those programs and that all studies be closely integrated.

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Collection and analysis of baseline data on aquatic and terrestrial wildlife throughout the area influenced by development, including downstream area. - relates to objectives #1 and 6 - essential prerequisites to studies G2,G5,L1,L2 G1, G4 - based on studies - compliments studies L1, L2, H4, F1, F2, G4, H2	- continuing information on wildlife populations is required in order to assess habitat, predict losses and guide planning. The effects of development will be felt well beyond the immediate development area hence those studies must include the total area of influence.	CWS AFW DU NPS	1 2 & 3 4 & 5 6 - 10 Total	40 60 40 100 240 6.0 MY	50 " " " -	50 " " " -	- - - - -	- - - - -	20 / 0.5 30 / 1.0 20 / 0.5 50 / 1.0 120 / 3.0	20 30 20 50 120
Detailed mapping of wildlife habitat units based on biophysical land classification and baseline survey data. - relates to objectives #1, 3 and 6 - essential prerequisite to studies L4, G1, G5, M2, M3, W11 - based on studies G1, L1, L2, G4 - compliments studies L3, W8, W10	- such information is basic to prediction of threat to wildlife and as an integral part of land use planning. The result will be a series of maps depicting wildlife habitat units and their associated values.	CWS AFW AP1B LD	1 2 & 3 4 & 5 6 - 10 Total	150 - - - 150 3.0 MY	- 33 " " -	- 66 " " -	- - - - -	- - - - -	- 50 / 1.0 - - 50 / 1.0	- 50 - - 50
Incorporate wildlife inputs into Regional Land Use plan. - relates to objectives #3 and 4 - essential prerequisite to studies L4 - based on studies G1, G2, G4, H3 - compliments studies L1	- to supply and interpret wildlife data input to the land use planning process.	AFW CWS AP1B LD	1 2 & 3 4 & 5 6 - 10 Total	- 25 50 25 100 5.0 MY	50 " " " -	50 " " " -	- - - - -	- - - - -	- 12.5 / 0.5 25 / 1.0 12.5 / 0.5 50/2.5	- 12.5 25.0 12.5 50

Sector Wildlife (G)

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Component: Cont. $000	Internal $000/MY	Total $000
G4 Inventory of rare and endangered wildlife species and their associated habitat. - relates to objectives #1, 6 and 7 - prerequisitive to studies G2, G3, G5, L3, L4 - based on study G1 H4, M5 - compliments to studies G1, M4, M5, L2	- eagles, falcons, pelicans, etc. are extremely sensitive to disturbance and their population status is largely unknown in this area.	AFW CWS	1	-	-	-	-	-	-	-
			2 & 3	60	50	50	-	-	30 / 1.0	30
			4 & 5	-	-	-	-	-	-	-
			6 -10	-	-	-	-	-	-	-
			Total	60 2.0 MY					30 / 1.0	30
G5 Development of computer simulation model of wildlife habitat and associated populations. - relates to objectives #3, 4, 6 and 7 - prerequisite to studies M4, L5, L4 - based on studies G1, G2, G4, A7, W1, W2, W3, W4, V6, V7, F1 - compliments to studies W1, W2, W4, W5, W6, W8 F3, A2	- to predict impact of developments in relation to tar sand development activities in the affected area including Peace-Delta.	CWS AFW	1	-	50	50	-	-	-	-
			2 & 3	100	-	-	-	40	10 / 0.8	50
			4 & 5	30	-	-	-	-	15 / 1.0	15
			6 -10	50	-	-	-	-	25 / 1.7	25
			Total	180 8.6 MY				40	50 / 3.5	90
G6 Determination of the impact of tailings reservoirs on wildlife and development of solutions to these problems. - relates to objectives #3, 5, 6 and 7 - prerequisite to study G7 - based on studies W7, W8, W9, V1 - compliments study M1,2, V7, V8, W12	- severe conflicts with wildlife, particularly waterfowl, are anticipated from these reservoirs and their associated contamination.	CWS EPS	1	35	20	-	80	-	7 / 0.5	7
			2 & 3	120	-	-	-	14	10 / 0.5	24
			4 & 5	25	-	-	-	10	9 / 0.5	19
			6 -10	175	-	-	-	20	15 / 1.25	35
			Total	425 18 MY				44	41/2.75	85

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Component Cont. $000	Internal $000/MY	Total $000
G7 Development of techniques to restore wildlife habitat on disturbed areas. - relates to objective #5 - prerequisite to study L4 - based on studies V1, V2, V7, G6 - compliments to studies V1, V2, V3, V4, V5, W8	- to provide guidelines and methodology on restoration programs.	CWS AFW DU	1	-	45	45	10	-	-	-
			2 & 3	-	-	-	-	-	-	-
			4 & 5	80	-	-	-	20	16 / 1.0	36
			6 -10	120	-	-	-	30	24 / 1.5	54
			Total	200 7.8 MY				50	40 / 2.5	90
Summary of Wildlife Sector. Note: Wildlife considerations also included in Lands, Forestry and Water Sectors.			1	75	-	-	-	-	27 / 1.5	27
			2 & 3	515	-	-	-	54	142 / 5.3	196
			4 & 5	295	-	-	-	30	85 / 5.0	115
			6 -10	470	-	-	-	50	127 / 6.7	177
			Total	1355 77 MY				134	381 / 18.5	515

Fisheries major concerns in the matter of Athabasca Tar Sands Development are the definition and protection of existing resources in the areas which could be affected.

Present extraction proposals provide for the containment of the tailings effluent on the lease. Serious contaminants can however, still enter the aquatic ecosystems via aerial paths, groundwater seepage, and from diverted or rearranged streams.

The impact of toxic chemicals directly on fish is of particular concern but secondary affects such as the effect of toxicants on food organisms as well as physico-chemical changes to the habitat of fish and associated biota necessarily must be investigated in depth.

As a first step it has been proposed to commence the acquisition of extensive baseline data regarding fishery resources and limnological parameters in order to have a firm basis upon which to judge impact. As judgements of potential impact must be made quickly in order to provide a preliminary report, it has been proposed that particular attention be focused on existing tar sand operations and that such studies form a basis for following the Syncrude operation as it goes on line. It is believed that studies such as these will provide real-time experience upon which to base advice to governments and upon which to design the other experiments outlined in the proposal.

	Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
F1	Collection and assembly of baseline information on the composition and abundance of aquatic biota throughout the system and existing levels of contaminants in aquatic organisms. - relates to objective 1 - prerequisite to study F3, G5, W11 - based on study - complements study G-1, W9, W10, L2	- to provide baseline data upon which to assess changes due to development - to contribute to development of water quality standards and effluent standards and regulations	FMS AFW EPS	1 2 & 3 4 & 5	150 750 600	50 50 50	50 50 50	- - -	- - -	75/3 375/6 300/6	75 375 300
				Total	1500/30	50	50	-	-	750/15	750
F2	Inventory of sport and commercial fishery as practiced in the area influenced by tar sand development. - relates to objective 1, 5 - prerequisite to study F3, L1, M2, M3, M5, H1 - based on study - complements study G-1, L1	- to provide fisheries inputs to land use plans - to determine impact of developments on the fishery resource	AFW FMS	1 2 5 8	- 30 40 50	- 50 50 50	- 50 50 50	- - - -	- 15 20 25	- - - -	- 15 20 25
				Total	120/3my	50	50	-	60	-	60
F3	Computer model of fisheries resources of the system to the head of the Mackenzie River. - relates to objective 4 - prerequisite to study L1 M2 - based on study F1, F2, W6 - complements study - H2, H3, G5, W4, W5, W6, A2	- to predict impact of changes in hydrology, sedimentation and water quality on the fishery resource	AFW FMS	1 2 & 3 4 & 5 6 - 10	- 50 20 60	- 50 50 50	- 50 50 -	- - - -	- 25 10 30	- - - -	- 25 10 30
				Total	130/3my	50	50	-	65	-	65
F4	Determine the potential impact of contaminants arising from tar sands development on fish and on other components of aquatic food webs using laboratory and field lethality and sub-lethality bioassays. - relates to objectives 3, 4 and 5 - prerequisite to study M2 - based on study F5, W2, W5	- to predict impact of contaminants on aquatic ecosystems - to provide guidelines for water quality standards - to assist in development of regulations and guidelines	FMS EPS ADOE AFW	1 2 & 3 4 & 5 6 - 10	500 1000 1000 500	50 50 50 50	50 50 50 50	- - - -	50 100 100 50	200/6 400/12 400/12 200/6	250 500 500 250
				Total	3000/	50	50	-	300	1200/36	1500

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Acquire real time experience through detailed study of the effect of GCOS operation on aquatic ecosystems including field toxicity surveys and surveys of selected chemical contaminants, followed by planning and implementation of similar studies at the Syncrude site when it becomes operational. - relates to objective 3, 4 and 6 - prerequisite to study F4, F6 - based on study - complements study F4, W3, W10	- to contribute meaningful data especially to the preliminary report with follow-up in the second report by analyzing the impact of the existing operation on aquatic systems - to predict impact of toxicants on aquatic systems	FMS	1	100	50	50	-	-	50/3	50
			2 & 3	200	50	50	-	-	100/6	100
			Total	300/9my	50	50	-	-	150/9	150
To determine in situ impact of water or airborne contaminants which have been defined as serious problems by other studies through the deliberate introduction of such toxicants into carefully selected small experimental streams or lakes. - relates to objectives 3, 4 and 5 - prerequisite to study W8, M3 - based on study A2, A6, F5 - complements study A7, A2, A3, W10	- to predict impact of contaminants on aquatic ecosystems - to assist in the development of water quality standards and effluent regulations and guidelines	FMS	1	-	-	-	-	-	-	-
		EPS	2 & 3	700	50	50	-	150	200/10	350
		ADOE	4 & 5	700	50	50	-	150	200/10	350
		AFW								
			Total	1400/40my	50	50	-	300	400/20	700

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Comments Cont. $000	Internal $000/MY	Total $000
Collection and assembly of baseline limnological information on Lake Athabasca, especially the areas influenced by the Athabasca River and the delta. - relates to objective 1 - prerequisite to study W6, M2, H4 - based on study W1 - complements study W3, L2	- to provide baseline information upon which to assess changes due to development - to contribute to water quality standards, regulations and criteria	FMS EPS	1	-	-	-	-	-	-	-
			2	-	-	-	-	-	-	-
			3 & 4	500	50	50	-	-	250/6	250
			5 & 6	500	50	50	-	-	250/6	250
			Total	1000/ 24my	50	50	-	-	500/12	500
Collection and assembly of baseline limnological information on the Slave River and west basin of Great Slave Lake. - relates to objective 1 - prerequisite to study W6, M2 - based on study W1 - complements study W3, L2	- to provide baseline information upon which to assess changes due to development - to contribute to water quality standards, regulations and criteria	FMS EPS DINA	1	-	-	-	-	-	-	-
			2 & 3	-	-	-	-	-	-	-
			4 & 5	-	-	-	-	-	-	-
			6 - 9	900	100	-	-	200	700/30	900
			Total	900/ 30my	100	-	-	200	700/30	900
	Sector Totals		1	750/ 23			-	50	325/12	375
			2&3	2730/ 76				290	1075/34	1365
			4&5	2860/ 79				280	1150/34	1430
			6-10	2010/ 51				305	1150/42	1455
			Total	8350/ 229.my				925	3700/122	4625

Multisector Programs

By their very nature, many projects cross a wide range of subject areas. Some do not relate specifically to any of the sectors identified yet demand equal status relative to their importance and contribution to the overall program.

Within this sector four general subject areas can be identified:

(1) Technology Development,
(2) Regulations and Guideline Development,
(3) Contingency Plan Development,
(4) Data Storage and Retreival.

Technology Development projects identified include studies of sulphur and fines control technology and coke utilization.

A critical review of the state of the art technology is suggested as a prerequisite to developing bench, pilot, and demonstration scale experiments. Federal and Provincial funding will be used as a catalyst to expedite necessary control development projects considered too costly by tar sands proponents.

Application of results obtained from air and water pollution studies is contingent upon the formulation of guidelines, regulations or, if required, the development of new legislation for environmental protection. For this reason, the projects identified in this area are considered critical to the overall intent of the program.

In view of the potential for pollution and/or contaminant transport via natural river systems and the atmosphere, the need to identify sources and types of contaminants associated with tar sands developments and methods for their containment under emergency conditions is essential. Pollutants and/or contaminants resulting from tar sands activities could have significant implications on the Peace-Athabasca Delta, Wood Buffalo National Park, and the upper Mackenzie River Basin.

Programs, such as those proposed, involving diverse disciplines and large volumes of data require a common data storage and retrieval system. This is particularly true of data obtained through long term monitoring programs. A system must be designed to permit data from all sectors to be collated, stored, and made available as the need arises.

Sector MULTISECTOR

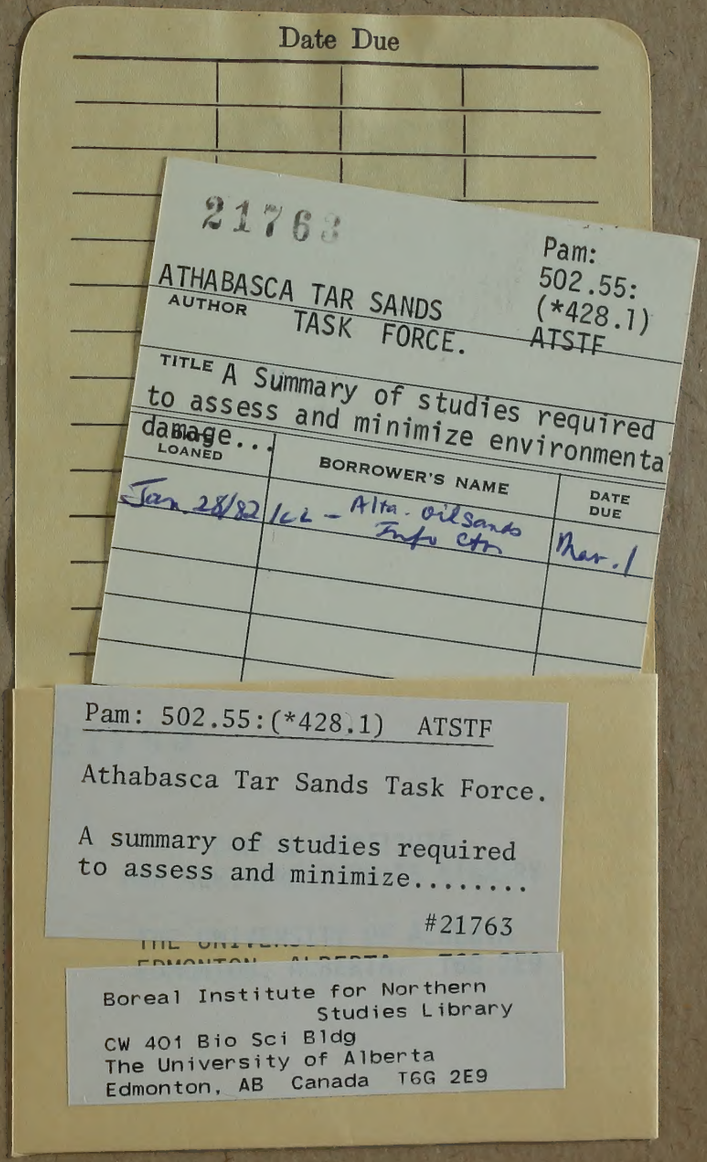
Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Cost.Cost Comments Cont. $000	Internal $000/MY	Total $000
ECHNOLOGY DEVELOPMENT										
Sulphur Removal Stack Gases.										
State of the Art and Economic Analysis	-to identify economically feasible processes for later pilot and demonstration scale trial. - to identify operating problems and process modifications and variables which should be examined for application to the Athabasca Tar Sands process and energy generation plants.	EPS ADOE EMR	1	50/2	50	50	0	0	25/1 (REVIEW)	25
te of the art review of existing SO_x ol technology presently considered ically feasible for 85-90% SO_x removal quired to identify processes which economically be applied to the Tar s situation. eview will include capital and operating costs and will identify operating lems. eview will also include information on esses currently being evaluated on the or demonstration scale for thermal generation, including wet lime/lime- scrubbing, magnesium oxide scrubbing, dium pentoxide add on catalytic combus-, sodium sulphate scrubbing, double di sodium sulphate scrubbing.										
t Scale Experiments	- to demonstrate best practicable technology	EPS ADOE EMR	2 & 3	825/2	33	33	33	250	25/1 (PROJECT MONITORING)	275
esses which appear economically and nically feasible according to the state e art review, will be carried to the t scale trial stage to develop design eria, determine process efficiencies, operational problems, examine feed-control possibilities, determine by-uct disposal requirements.										
nstration Scale Experiments	- to demonstrate best practicable technology	EPS ADOE EMR	4,5 &6	2,000 /4	35	35	30	650	50/2 (PROJECT MONITORING)	700
ll scale stack gas sulphur removal plant be designed from pilot plant data and illed at an existing tar sands plant.										
elates to objective #2 and 5 plements study A6, H5; based on studies			Total	2875/ 8				900	100/4	1000

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
Tailing and Recycle Fines Reduction Treatment										
State of the Art and Economic Analysis	- to identify economically feasible separation processes for later bench and pilot scale trial.	EPS ADOE ARC EMR	.1	50/2	50	50	0	0	25/1	25
ate of the art review of existing ings treatment technology involving ended fines reduction is required to ntify processes which could economically pplied to the Tar Sands situation.	- to identify extraction process constraints for fines contamination									
review will include capital and operatin; ts and will identify operating problems.										
review will also characterize and ntify the mineralogical composition and ticle size distribution of tailings. It l identify processes of primary bitumen traction where suspended fines buildup contamination must be controlled. A rature review of all unit processes and s transfer theory which may apply will be ucted ; e.g. coagulation, flocculation, trifugation, filtration, etc.										
h Scale Experiments	- to demonstrate best practicable technology	EPS ADOE ARC EMR	2&3	500/2	35	35	30	150	25/1	175
esses which appear economically and nically feasible according to the state he art review, will be carried to the h scale trial stage.										
inuous flow bench scale pilot plants wil onstructed and/or purchased and the se- ed treatment processes will be studied r dynamic conditions to evaluate the ctiveness of the process, design meters, operational characteristics, rol requirements and economic iderations.										

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Components Cont. $000	Internal $000/MY	Total $000
emonstration Scale Experiments full scale tailings or fines recycle reatment plant will be designed from ontinuous flow bench scale pilot plant cts and installed at an existing plant. relates to objective #2 and 5 compliments study W9, V7, V8, G6, W2, W12, H5 based on study H3	- to demonstrate best practicable technology	EPS ADOE ARC EMR	4,5 &6	1200/ 4	33	33	33	350	50/2	400
			Total	1750 /8				500	100/4	600
1.3 Coke Utilization State of the Art and Economic Analysis state of the art review of existing ther- l power generating stations and coal sification complexes is required to entify processes which could be applied the Tar Sands situation. e review will include capital and erating costs and will identify operating oblems. e review will look at coal gasification mplexes which utilize high sulphur coals t are capable of adopting high sulphur ke. The problem of sulphur removal from ke, a constraint for utilization, will ay an important role in any processes nsidered.	- to identify economically feasible processes for later pilot and demonstration scale trials where coke could be used in its present or altered form for the generation of power and steam. - to identify processes for later trials wherein coke may be gasified to replace process or natural gas as fuel for hydrogen production plants.	EPS ADOE AES	1	50/2	50	50	0	0	25/1 (REVIEW)	25
lot Scale Experiments ocesses which appear economically and chnically feasible according to the ate of the art review, will be carried the pilot scale trial stage.	- to demonstrate best practicable technology	EPS ADOE AES	2&3	600/ 2	33	33	33	175	25/1 (PROJECT MONITOR- ING)	200

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Commitment Cont. $000	Internal $000/MY	Total $000
nstration Scale Experiments l scale coke burning plant will be ned from pilot plant data and illed at an existing plant. lates to objective #2 and 5 ed on study H.3 plements studies V1, V6, H5	- to demonstrate best practicable technology	EPS ADOE AES	4,5 &6	1,500 /4	33	33	33	450	50/2 (PROJECT MONITOR-ING)	500
			Total	2150 /8				625	100/4	725
WATER POLLUTION REGULATION AND GUIDELINE DEVELOPMENT lates to objective #5 sed on studies A7, W9, V8, G2, F2, F3, F4 F7, F8, W11 requisite to study M5	- to review results of wat pollution studies and develop suggestions for appropriate controls - to influence regulatory actions within EPS/DOE program and policy framework	r EPS ADOE FMS IWD	1 2&3 4&5 6-10	20/1 30/1 80/1 120/2	50 50 50 50	50 50 50 50	0 0 0 0	0 0 0 0	10/.5 15/.5 40/.5 60/1	10 15 40 60
			Total	250/5					125/2.5	125
Air Pollution Regulation and Guidelin Development lates to objective #5 ed on studies A2, A3, A4, A5, A6, A7, V6, G2, F6 requisite to study M5 plements study A1	- to review results of air pollution studies, and develop suggestions for appropriate controls - to influence regulatory actions within EPS/DOE program and policy framework	EPS ADOE	1 2&3 4&5 6-10	50/½ 100/1 100/1 250/4	50 50 50 50	50 50 50 50	0 0 0 0	0 0 0 0	25/1 50/1 50/1 125/2	25 50 50 125
			Total	500/10					250/5	250

Research Required	Purpose	Agencies	Year	Total Cost $000/MY	Suggested cost Sharing (%) Fed.	Prov.	Priv.	Fed.Govt.Cost Component Cont. $000	Internal $000/MY	Total $000
Information Processing and data storage and distribution Storage and retreival centre is required to facilitate immediate access to data obtained from monitoring and surveillance activities. lates to objectives #3 and 4. sed on studies A4, A5, A6, A7, W8, W9, W8 F2, A2 plements studies G4, A1 requisite to several studies	- to coordinate the provision of analytical data obtained through monitoring and surveillance activities. - to develop a data access and storage program for computer access to the information	EPS ADOE WRB	1 2&3 4&5 6-10 Total	50/2 20/1 20/1 30/2 120/6	50 50 50 50	50 50 50 50	0 0 0 0	25 0 0 0 25	0 10/.5 10/.5 15/1.0 35/2.0	25 10 10 15 60
Environmental Emergencies and Contaminants Control (Contingency Plans Development) ates to objectives #2 and 5 ed on studies A2, A3, A4, A5, F2, M2 M3, G4 lements study G4	- to analyze preparedness for contingency measures for environmental emergencies of any magnitude - to identify raw materials wastes or products used to their threat to the environment and/or man. - to develop storage techniques; waste handling procedures or contingency measures for the handling and/or control of environmentally dangerous materials.	EPS	1 2&3 4&5 6-10 Total	60/4 120/8 120/8 300/2 600/4	33-1/3 " " " "	33-1/3 " " " "	33-1/3 " " " "	0 " " " "	20/.2 40/.4 40/.4 100/1 200/2.0	20 40 40 100 200
	Multisector	Total	1 2&3 4&5 6-10 Total	330/5 2195/10.8 5020/16.8 700/10 8245/49				25 575 1450 0 2050	130/4.7 1905/5.4 2907/8.4 300/5 910/23.5	155 765 1740 300 2960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